shows the shapes of, and the positional relationship between the magnetic domain control film **11**, and each of the free layer **7** and the pinned layer **5**. When the thickness of the Co alloy thin film is reduced, the thickness is reduced at the inclined portion of the end of the magnetoresistive element and a step is formed in the film shape thereat and, when magnetization H is directed to the track width, a demagnetizing field Hd is generated in the inclined portion to weaken the effective bias magnetic field. It is usually intended to apply the bias magnetic field only to the free layer **7**, but the magnetic field is dispersedly applied to the pinned layer **5** and the shield layer **1**, in the shapes shown in **FIG. 4**(*c*) and it cannot be said to be a structure for appropriately applying the bias magnetic field to the free layer. Further, the magnetic domain control film formed at the inclined portion of the end of the stack of magnetoresistive layers has a shape of a thin film inclined from the magnetizing direction. In addition, it is probable that intense positive and negative magnetic charges are generated on the inside and the outside thereof to form the demagnetizing field Hd inside the ferromagnetic body of the inclined portion. The demagnetizing field weakens the bias magnetic field intended to generate and no appropriate magnetic field can be applied to the free layer **7**. Further, the angle of inclination ($\alpha$) for the inclined portion at the end of the stack of magnetoresistive layers acts to weaken the magnetic charge density to weaken and disperse the bias magnetic field.

[**0026**] Further, the magnetic domain control film is formed by using a lift-off resist such that the thickness of and a portion near the top end of the magnetic domain control film **11** is generally reduced, and the top end formed thinly has a shape covering the upper surface of the free layer. It has been known that when the thickness of the Co alloy magnetic thin film is reduced to as thin as several nm, the magnetic characteristics thereof are lowered and the film becomes thermally instable. Accordingly, it is probable that the top end of the magnetic domain control film **11** also acts to disturb the bias magnetic field to be applied to the free layer **7**.

[**0027**] It is considered that the magnetic domain control bias magnetic field should be applied to the free layer **7** and a magnetic field of higher intensity should be applied to the end of the free layer by a magnetic film whose vertical position is aligned with that of the free layer. In this case, it is expected that the bias magnetic field is applied more appropriately to the free layer **7** by adopting the structure of **FIG. 4**(*b*), that is, a structure as shown in **FIG. 1** in which the vertical position of the free layer **7** is aligned with that of the magnetic domain control film **11**.

Problem of Magnetic Characteristics

[**0028**] However, when a Co alloy magnetic thin film having a Cr underlayer used as the magnetic domain control film **11** is formed on an MnPt alloy thin film, MnIr alloy thin film, or on CoFe or NiFe used as a pinned layer of the stack of magnetoresistive layers, the magnetic characteristics thereof are deteriorated and the bias magnetic field cannot be applied to the free layer **7**. That is, when a Co alloy thin film (magnetic domain control film **11**)/Cr underlayer (magnetic domain control film underlayer **10**) is formed on the thin film of the material used for the pinned layer **5**, it resulted in a thin film having characteristics that the coercivity and squareness of the magnetization curve are lowered and the amount of residual magnetization cannot be maintained. As a result of various studies, this is attributable to that fitting is poor between the crystal system of the material constituting the stack of magnetoresistive layers and the crystal system of the Co alloy thin film/Cr underlayer (magnetic domain control film **11**/magnetic control domain film underlayer **10**) of good magnetic characteristics and, accordingly, a hetero-epitaxy mechanism results in a crystal structure of lowering the magnetic characteristics of the Co alloy thin film/Cr underlayer thin film when the Co alloy thin film/Cr underlayer are formed on the crystal system of the material constituting the stack of magnetoresistive layers.

[**0029**] While most of the layers of the stack of magnetoresistive layers are face-centered cubic (fcc) system polycrystal thin film, the Cr underlayer (magnetic domain control film under layer **10**) used as the magnetic domain control layer is a body-centered (bcc) polycrystal thin film, and the Co alloy magnetic film (magnetic domain control film **11**) is a hexagonal closed packed (hcp) polycrystal thin film. The Cr underlayer (**10**) used as the underlayer for the Co alloy magnetic film is used for controlling the crystallographic orientation and the crystal inner strains of the Co alloy magnetic film hexagonal systems by the hetero-epitaxy crystal growing mechanism and, as a result, a Co alloy magnetic film having high coercivity and high squareness can be obtained. On the other hand, when the Cr underlayer and the Co magnetic film are formed on the face-centered-cubic lattice magnetoresistive element, the hetero-epitaxy crystal growing mechanism exerts between the stack of magnetoresistive layers and the Cr underlayer and, as a result, gives an undesired effect on the crystallographic orientation and the lattice strain of the Cr underlayer and the Co alloy magnetic film, to deteriorate the magnetic characteristics. It has been found that the thin film **5** of Co alloy thin film/Cr underlayer less shows good magnetic characteristics on the thin film constituting the stack of magnetoresistive layers.

[**0030**] On the other hand, when the crystal structure of the stack of magnetoresistive layers is formed into a better face-centered cubic (fcc) crystal structure, the magnetoresistive characteristics are improved. It has thus been found that the crystal structure of the stack of magnetoresistive layers cannot be changed.

[**0031**] The fact that the Co alloy thin film on the Cr underlayer cannot provide good magnetic characteristics on the thin film constituting the stack of magnetoresistive layers also shows that the portion on the inclined surface of the Co alloy magnetic domain control film at the end of the stack of magnetoresistive layers in the existent structure is in a crystal state of deteriorated magnetic characteristics. It is estimated that deterioration of the characteristics at the top end of the magnetic domain control film induces lowering of the bias magnetic field and disturbance of the bias magnetic field and it is probable that this constitutes a cause of deteriorating the magnetic domain control film properties.

[**0032**] The problem with the deterioration of the magnetic characteristics at the inclined portion cannot be solved even adopting the system of increasing the thickness of the Cr underlayer and aligning the vertical positions of the free layer and the magnetic domain control film as described, for example, in Patent Document 2. Further, in a case where the thickness of the Cr underlayer is increased, the thickness of